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THESIS

STUDY OF AN ALTERNATIVE CAREER PATH FOR DECK OFFICERS IN THE HELLENIC NAVY

by

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March 2013

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The present research seeks to determine if a second career path could be created to operate in tandem with the existing one. By introducing a second, parallel path, the HN would have greater flexibility in how it uses its deck officers. Additionally, a second career path might benefit officers who have special skills, allowing them to progress through the ranks based on different criteria, such as technical expertise. The net result could help to lower the Navy's operating costs during a time of economic uncertainty in Greece.

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STUDY OF AN ALTERNATIVE CAREER PATH FOR DECK OFFICERS IN THE HELLENIC NAVY

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ABSTRACT

Since the first days of the Hellenic Navy, deck officers have come from the Hellenic Naval Academy (HNA). Currently, all the deck officers, after graduation from the HNA, follow a direct but simple course of advancement. At each rank deck officers must successfully fulfill certain career assignments (known as *milestones*) to continue on their career path in the HN.

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LIST OF ACRONYMS AND ABBREVIATIONS

AO	Fleet Oilers
CIC	Combat Information Center
CO	Commanding Officer
DC	Damage Control
DDGH	Guided-Missile Destroyer with Helicopter(s)
FFGH	Guided-Missile Frigate with Helicopter(s)
HAF	Hellenic Armed Forces
HMoD	Hellenic Ministry of Defense
HMoE	Hellenic Ministry of Education
HN	Hellenic Navy
HNA	Hellenic Naval Academy
HNDGS	Hellenic National Defense General Staff
HNGS	Hellenic Navy General Staff
MCM	Minesweeper
PHM	Hydrofoil
RHN	Royal Hellenic Navy
SWO	Surface Warfare Officer
TAO	Tactical Action Officer
UDT	Underwater Demolition
USA	United States Army
USMC	United States Marine Corps
USN	United States Navy
XO	Executive Officer

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Many times in our lives, we have certain ideas about what we want out of life, but then something completely different happens. This journey, which started back in 2009, after the zealous support and encouragement of my wonderful wife, Rea, has been one of those times. She and my beloved son, Giorgos, gave me the strength and patience not only to start this journey, but also to reach the end full of experience, knowledge, and unbelievable memories.

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I. INTRODUCTION

A. BACKGROUND

Since the first years of the Hellenic Navy (HN), deck officers have come from the Hellenic Naval Academy (HNA). The HNA, also called the Hellenic Naval Cadets Academy *(Σχολή Ναυτικών Δοκίμων),* started its educational and naval training courses on November 24, 1845. It is one of the first institutions established for education/training in Hellas (Greece). Currently, all the deck officers of the HN, after their graduation from HNA, follow a direct but simple course way of advancement. At each rank, all deck officers must successfully fulfill certain career assignments (known as -*milestones*-) to continue on their career path in the Hellenic Navy.

The present research seeks to determine if a second career path could be created to operate in tandem with the existing one. By introducing a second, parallel path, the HN would have greater flexibility in how it uses its deck officers. Additionally, a second career path might benefit officers who have special skills, allowing them to progress through the ranks based on different criteria, such as technical expertise. The net result could help to lower the Navy's operating costs during a time of economic uncertainty in Hellas.

B. RESEARCH OBJECTIVES

With this thesis, I examine the feasibility of having a second, alternative career path for deck officers in the HN. The study aims to design and evaluate an optional career path model for HN officers and to specify its corresponding billet requirements. I design and evaluate the alternative model and then I compare the alternative model to the existing career path to determine its potential effectiveness in achieving improved productivity, and flexibility.

C. RESEARCH QUESTIONS

The present study attempts to answer three primary questions and two secondary questions, as follows:

1. Primary Research Questions:

- Should the HN have a second, alternative career path for deck officers?
- Could two parallel structures for the deck officers operate together effectively?
- Would the introduction of a second career path provide the desired outcome of improved productivity and flexibility?

2. Secondary Research Questions:

- What actions or systems would be needed to ensure that two separate structures could operate together most effectively?
- What types of further research (e.g., a pilot program) would be required to determine feasibility?

D. THESIS SCOPE AND METHODOLOGY

The scope of this thesis includes the following:

1. A literature review of similar issues in the U.S. Navy (USN) and in other services.

2. The development of a detailed application model that would separate the deck officers inside the HN into two parallel "career paths."

3. Specification of billet requirements that the deck officers would need to follow to remain at any structure or to change their structure.

4. Determination of changes that might need to be made regarding evaluations reports and the existing system of advancement, to broaden the information base for introducing and monitoring a more realistic and reliable mechanism inside the structure of the HN.

The methodology used in this thesis research consists of the following steps:

1. Gather and analyze information concerning deck officers of the HN, such as skills, level of performance, education/training, and other important factors.

2. Conduct a literature review of related research, policies, and structures in the USN that might apply to the HN.

3. Design and assess a potential model for the HN that might achieve improved productivity, flexibility, and performance.

4. Analyze results, offer conclusions, and recommend further actions based on the study.

E. ORGANIZATION OF STUDY

The study is organized into five chapters. Chapter II provides a literature review about the deck officers' inventory of the HN, the existing billets requirements for advancement and career paths in the HN, and the career paths of the USN's surface warfare officers; formulates the problem; and introduces a new model in the HN. Chapter III describes the methodology that is used for the introduction of the new model, based on the literature review. In Chapter IV, all the results are analyzed thoroughly, new billets requirements are introduced, and additional applications for the HN are provided (e.g., other personnel categories). Chapter V summarizes the research, followed by conclusions and recommendations based on the results of each research question (primary and secondary). Research recommendations for the future are given.

F. EXPECTED BENEFITS FROM THE STUDY

This study attempts to find an alternative career path for deck officers in the HN. The introduction of key elements from successful systems in the militaries of other nations may help the HN to increase motivation among deck officers and optimize their performance.

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II. BACKGROUND AND LITERATURE REVIEW

A. DECK OFFICERS INVENTORY OF THE HELLENIC NAVY

The main source of all the officers in the HN is the Hellenic Naval Academy (HNA). In the past, and especially during periods of war, mobilizations, and other special situations, there have been other sources for officers in the HN. Most of those officers came from the Commercial Navy and its sailors, and it is something very familiar with the nature of Hellenes (Greeks). To better understand the role of the HNA, it is important to quote some information concerning the HNA, the main source of deck officers in the HN. Information regarding the history of the HNA, the kind of education provided to the naval cadets in the HNA, and the professional options available to cadets who graduate from the HNA.

1. Brief History of the Hellenic Naval Academy

The HNA has a very long history in naval education. In 1830, not long after the War of Independence, Hellas became a country-state as a result of the second London conference (a conference of ambassadors of the three protecting powers of that period – Britain, France, and Russia), and on November 30, 1829, the London Protocol, established the borders of Hellas and gave full independence and sovereignty to the new country-state. The new country-state needed basic organizations for its institutions, especially the armed forces to protect itself from external enemies. There were continuous efforts to educate and train officers ("Hellenic Navy." n.d.). However, the inefficient training of the officers, the conflict between those with modernizing ideas concerning naval art and old-fashioned experienced sea-fighters of the struggle for independence, as well as the national problems of the times, resulted in the restricted, inefficient, and poorly organized utilization of the navy, which was limited to national transports, guarding of the sea borders, and battling piracy.

The HNA was founded on November 24, 1845, to be the core of the Royal Hellenic Navy (RHN) as a school providing naval training at theoretical and practical levels. Because of the absence of permanent building facilities, the HNA used warships

to provide training. The HN corvette *Loudovikos* was the first home of the HNA and Lieutenant Commander Leonidas Palaskas was its first director. For the next 50 years, the HNA used various warships as bases for training because of the lack of available locations. In August 1884, there was an official opening of temporary shore facilities. Finally, in 1905, the HNA installed in Piraeus its permanent building facilities which remain until the present day. Each year since the foundation of the HNA, sea training and education haves evolved, reformed, and developed in accordance with what the HN wanted or needed. For more than 150 years of operation, the HNA has been made one of the most significant educational foundations in Hellas and gained higher distinctions, which have added validity and prestige. Almost 5,000 naval officers have graduated from the HNA. They have become not only the leaders in the HN, but also have distinguished themselves in politics, science and technology. ("History of Hellenic Naval Academy," n.d.)

2. Training and Education in the Hellenic Naval Academy

Training and education in the HNA are divided into two major branches or categories, the academic and naval training. Both are necessary for all the naval cadets to complete in order to receive as much as they can from the academy.

a. Academic Training

Cadets are accepted to the HNA through examinations of the Hellenic Ministry of Education (HMoE). In the HNA cadets have two separate directions, deck and engineering. The HNA is a higher educational institution equal to universities. Training is organized into four years (classes/cohorts). The ultimate goal of this specific academic training is for all of the cadets to receive the proper knowledge and education needed to fulfill the needs of the HN. The academic training covers a huge variety of scientific fields that support naval education. ("Academic training." n.d.)

b. Naval Training

Naval training is divided into winter naval training, summer naval training, and training based on simulators.

(1) Winter naval training: Winter naval training is basically sails with ships of the HN fleet (frigates, auxiliary ships, fast patrol boats, gun boats, submarines and minesweepers). The goal of winter sails is for all the naval cadets (of all the classes) to obtain as much experience as they can aboard ships to gain knowledge for sea operations and navigation, improve sea skills, and become acquainted with the sea element. Other sails are made with sailing boats for familiarity and amusement.

(2) Summer sea training: The summer training is based on the summer sail that is conducted every year from July until August. The duration of the summer training sails is approximately 45 to 50 days at sea, aboard frigates and auxiliary ships. Summer training sails are made into harbors of Europe, North Africa, and Middle Eastern countries in the Mediterranean Sea and the Atlantic Ocean. ("Naval Training", n.d.)

(3) Training based on simulators: Another significant, and also very important part of naval training is based on simulators. Simulators are for navigation, naval operations in the Combat Information Center (CIC), and Damage Control (DC) for all the cadets. ("Naval Training. " n.d.)

3. After Graduation From the HNA

Upon graduation (for cadets who have successfully concluded academic and naval training) all the deck officers join the Hellenic Fleet and are commissioned as Ensigns (O-1's) in warships of the HN. They have to remain in service for at least twelve years as officers in the HN. In the early stages of their career, the new officers serve in warships and attend schools providing specialized education to gain more professional experience and become familiar with the organizational and operational needs of the warships. Furthermore, they have the opportunity to make a choice as to whether to follow a career in special branches of the Service, such as submarines, helicopters, navy aviation, and special forces (underwater demolition or UDT). In later stages of their careers, deck officers may receive a Masters' degree domestically or abroad in universities such as the Naval Postgraduate School (NPS), the University of Michigan in United States (USA), the University of Grandfield in England, and so forth becoming further specialized in

such areas as electronic engineering, weapon systems engineering, computer engineering, operational research, naval architecture, and so forth.

All of the deck officers have sea tours, as well as shore tours, at the headquarters of ship command, at Hellenic Fleet Headquarters, at Hellenic General Staff Headquarters (HNGS) and/or at the Hellenic Ministry of Defense (HMoD) or Hellenic National Defense General Staff (HNDGS). They also have the opportunity to serve abroad in Greek embassies as defense/naval attachés, and in NATO positions (in Europe and in the USA) as department coordinators or assistant coordinators. The ultimate goal in the career path of a deck officer is to become chief of the Hellenic Navy at the grade of vice admiral (O-9), the highest rank inside the HN. ("Officer's career." n.d.)

4. Current Inventory of Deck Officers in the HN

For many decades the pyramid structure in the HN has been represented in accordance with the inventory of the deck officers. However, a tremendous increase of accessions at the HNA, which appeared in the mid 1980s, has caused problems in the career path of the deck officers and the way of their promotion/development.

The current inventory of the deck officers in 2012 is shown in Table 1. This table shows that there are no separations in the amount of billets at the first two pay grades of ensign (or O-1's) and lieutenant junior grade (or O-2's). It is clear that the total number (summary) of O-1's and O-2's is less than the corresponding billets. One explanation for this is the small number of accessions in the HNA over the past four years, as is shown in Table 2 (classes/cohorts of 2009, 2010, 2011, and 2012 with corresponding accessions of 24, 18, 25, and 24). In all of the other pay grades and specifically for lieutenants (or O-3's), lieutenant commanders (or O-4's), commanders (or O-5's), and captains (or O-6's), the number of the deck officers at each rank exceeds the corresponding billets.

Table 1. Number of Existing Deck Officers and the Corresponding Billets in Each Pay Grade in the Year 2012

Pay grades in HN	Existing number of deck officers	Billets
Ensign (or O-1)	96	400

Lt Junior Grade (or O-2)	233	
Lieutenant (or O-3)	327	284
Lt Commander (or O-4)	299	217
Commander (or O-5)	216	198
Captain (or O-6)	87	79
Commodore (or O-7)	19	18
Rear Admiral (or O-8)	7	7
Vice Admiral (or O-9)	3	3

All promotions inside the HN are made by completion of years in service and fulfilling all the needed requirements at each pay grade. Another very important and interesting point is that all promotions to the next pay grade are made by the criterion of classes/cohorts (a class/cohort refers to the all of the deck officers that graduated in the same year). This is one of the notable features of the HN.

Table 2 shows the deck officers' inventory in the HN at the ranks of ensigns, lieutenant junior grades, lieutenants, lieutenant commanders, commanders, and captains. Their distribution is based on the class/cohort of graduation and the number of graduates each year from 1984 until 2012. From this deck officers' spectrum it is obvious that the number of deck officers fluctuates each year. For example, there are classes/cohorts of 16 or 18 deck officers (class/cohort of 1984 and 2010), while some others with 71 or 65 (class/cohort of 1998 and 1996). Those fluctuations happened, because of the different number of accessions in the HNA all these years. This phenomenon has created the –need- for an alternative –career path- to be applied for the deck officers in the HN or to modify the existing one. The shaded areas in Table 2 show the deck officers who have been excluded from the promotion requirements for various reasons. All the other deck officers are inside the career path for promotion and development.

Table 2. Information for Classes (Number of Graduates and Year of Graduation) in the Year 2012

	Ensigns (O-1's)	Lieutenants Junior Grades (O-2's)	Lieutenants (O-3's)	Lieutenants Commanders (O-4's)	Commanders (O-5's)	Captains (O-6'Ts)
	Year-Grads	Year-Grads	Year-Grads	Year-Grads	Year-Grads	Year-Grads

	2009	24	2004	40	1998	73	1992	39	1987	15	1982	3
	2010	18	2005	45	1998	2	1992	1	1988	33	1983	2
	2011	25	2005	13	1999	59	1993	47	1989	49	1984	18
	2012	29	2006	38	2000	36	1994	37	1989	1	1984	2
			2007	36	2001	48	1994	4	1990	48	1985	16
			2008	61	2001	1	1995	55	1990	1	1986	23
					2002	48	1995	1	1991	60	1986	1
					2003	60	1996	65	1992	9	1987	22
							1997	50				
Summary		96		233		327		299		216		87
Available deck officers for promotion		96		220		324		293		214		79
Excluded		0		13		3		6		2		8

The following paragraphs, describe the course of promotions and career paths for officers in the U.S. Navy (USN), and especially surface warfare officers (SWOs).

B. CAREER GOALS OF A SURFACE WARFARE OFFICER IN US THE NAVY

In the USN, according to the *Naval Officer's Planning Guidebook* NAVPERS 15605 (U.S. Navy, Department of Personnel, 1990), and more specifically from the Master's thesis, *The Effect of a US Navy Reduction in Forces on the Career Path of Surface Warfare Officers Progressing to Command at Sea* (Bertolino, 1990), all the officers follow a strict career paths. The following discussion of the SWO career path in the USN shows the similarities with the career path used by the HN:

> All the SWOs have as their main and major purpose to get command at sea. As command at sea is defined for being the commanding officer (CO) of an ocean going ship; On the one hand the command of a guided missile destroyer (DDGH) or a guided missile frigate (FFGH) is considered command at sea. On the other hand command of a minesweeper (MCM) or a hydrofoil (PHM) is

not. At the present time, the first opportunity for command at sea occurs at the rank of commander (O-5). Commanders who successfully complete a command sea tour are later eligible to command larger, designated as major commands, at the rank of captain. A surface warfare officer (SWO) in the USN follows a very strict career path to the chain of command. The career path is composed of sea and shore tours (deployments). Those tours may vary in length and of course in intricacy. On the one hand sea tours are the basic in which a SWO evaluated. These sea tours provide to SWO the opportunity to gain higher qualifications and skills (in command, leadership, and management). On the other hand shore tours are not only a short relief break of the demanding pace at sea but also provide to SWO the opportunity to fulfill his/her requirements (Staff officers schools, Naval Postgraduate School, War College etc.). At USN the first tour that a SWO serves is the division officer tour. This tour is for three years and provides the SWO with an opportunity to apply, develop, and sharpen his/her qualifications and skills. At his/her command the SWO has a small number of enlisted personnel under his/her command pertaining to a specific area of sea operations (e.g. the communications officer is in charge of all the signal/radio personnel). A division officer is eligible to rotate to shore duty at the completion of his/her tour only if he/she has been selected by a department head selection board. The department head selection board chooses a division officer based upon his/her performance and selection signifies that the officer is not a department head selectee at the completion of his/her division officer tour, then he/she will serve an additional eighteen month division officer tour. Officers who are department head selectees will be assigned a two year shore tour. The shore tour following the first sea tour is primarily designed to give an officer a welcome break from the rigors of sea duty. A SWO has the opportunity to fill a multitude of billets during this tour. Shore tours can be in such diverse areas as recruiting, teaching, or stuff duty. Alternately, SWO's can use this tour as a chance to obtain postgraduate education. Upon completion of this tour the SWO will proceed to department head training. If an officer is assigned a second division officer tour, this tour must be taken in place of a shore tour in order the officer to remain "on track." The second division officer tour provides a SWO with the chance to gain the additional experience and evaluations required for department head selection. This tour is more complex the first one and is designed for an experienced division officer. While the number of the enlisted personnel of whom a second tour division officer is in charge is also between fifteen and thirty, the division itself is one of the more critical and important divisions on the ship (e.g.,

damage control or navigation). Because of the need to fill these positions with competent and experienced officers, sometimes department head selectees are also assigned second division officer tours. Second division officer tours provide qualified SWO's with the chance to obtain additional qualifications (such as Engineering Officer of the Watch) without the burden of concurrently trying to achieve their initial Surface Warfare qualifications. Upon the completion of the second division officer tour, an officer will then proceed to department head school. Surface Warfare Officer Department Head School is a six month school that prepares SWO's for duty as department heads. Additionally, upon completion of this school, many officers will attend follow-on schools that will cover specific aspects of their upcoming tours. Because of the duration of the period for department head school and any follow-on schools, department head preparation is considered a tour in itself. The school consists of two parts. The first 17 weeks consist of combat systems training, engineering fundamentals, and other related training. Approximately three months after course commencement, officers receive their orders and are broken up into groups which reflect the specific departments in which they will be serving. The second phase of the course is seven weeks long and focuses on the systems, requirements, and responsibilities of these departments. Upon completion of the department head school and follow-on training, SWO's will proceed to their department head tours. The department head tour is a sea tour which consists of two 18 month tours or one 30 month tour. A department head is in charge of a general area of shipboard operations. For instance, the chief engineer is the department head responsible for all the engineering functions of the ship. Specifically, this includes the ship's propulsion, auxiliary and electrical systems, as well as repair and damage control. Each of these individual areas is controlled by a division officer, while the department head has overall responsibility. Typically, the department head will have two to four division officers and 50 to 100 enlisted personnel under his/her command. While serving his/her department head tour, a SWO is expected to make progress towards command at sea qualifications. This includes achieving a tactical action officer (TAO) qualification. TAO qualification means that the Captain of the ship has given authority to the officer to fight the ship (i.e., fire weapons) in his/her absence. Additionally, an SWO is also expected to qualify as an engineering officer of the watch in order to manage and/or supervise the running of the engineering pant. These specific qualifications can be obtained at any point prior to command qualification, but are usually achieved by the conclusion

of the department head tour. As mentioned previously, the department head tour can be served as one or two tours. The single 30 month department head tour is designed for those officers with the experience in a particular department, and on those ships where greater department head continuity is required for successful shipboard operations. For instance, this includes the chief engineer positions on the fleet oilers (AO) and guided missile destroyers (DDGH). The two 18 month department head tours, or split tours as they are commonly referred to, usually take place on two different type ships. The second department head tour will be in a more complex position than the first. It will typically be on a larger ship and can include at the sea staff duty instead of command of a department. Whatever the case, split touring puts experienced officers in the most challenging billets as well as exposing them to a variety of ships. Upon completion of the second department head tour or he single length department head tour, SWO's rotate to shore duty. The second shore tour is typically three years in length and enables the officer with a chance to pursue further professional development. If an officer attains a postgraduate education in specific areas, he/she can gain a subspecialty qualification. Officers who already have a subspecialty will most likely be assigned a shore duty position which puts it to use. Additionally, a SWO can attend joint training and serve a joint tour. Upon completion of this tour, and after selection by the XO selection board, a SWO will attend a six week executive officer tour and will then proceed to his/her XO tour. The XO tour is 18 months long and is by far the most demanding of the pre-command sea tours. The XO is second in command on the ship and typically has between ten to 15 officers and 100 to 300 enlisted personnel under his/her charge. The XO is responsible for all facets of the ship's operation from personnel training to shipboard maintenance to navigation. While serving as XO, an SWO will complete his/her command qualifications if they have not already been completed. The command qualification process culminates with an eight hour written test and with an extensive oral board administered by the ship's CO and two other CO's. In order to be screened for command at sea, an SWO must first have completed his/her command qualifications, and then he/she is eligible to rotate to shore duty. The third shore tour is three years in length and serves as a career catch-all. An SWO has the opportunity to serve in a joint, subspecialty, Washington D.C., major staff, or training command tour depending upon which type tour he/she has not yet served. Additionally, an officer may receive advanced training by attending the Naval War College or the Senior Service College. SWO's who are selected for command at sea attend a ten month

> pre-command course upon completion of their shore tour and then rotate to Command. The CO tour is a two-year sea tour. The CO is responsible for all actions of his/her ship and its crew. The CO is typically in command of the ship's complement consisting of 100 to 400 officers and crew. SWO's who successfully complete a CO tour are eligible for major command, commanding larger ships such as guided-missile cruisers (CG), and promotion to the rank of captain (O-6). (pp. 3–7)

The promotion flow inside the USN is depicted in Table 3. The second and the third columns in Table 3 provide the earlier promotion probabilities at each rank and especially in O-4, O-5, and O-6. Also, the fifth column shows the success rate of promotions in the USN at each rank.

Table 3. Promotion Flow in the US Navy (from U.S. Navy Military Development Center, 2012)

Rank	Time in Service	Time in Grade	Process	Success Rate
O-2	2 Years	2 Years	Fully Qualified	Nearly 100%
O-3	4 Years	2 Years	Best Qualified-Selection Board	95–100%
O-4	9– 11 Years	3 Years	Best Qualified-Selection Board	80%
O-5	15– 17 Years	3 Years	Best Qualified-Selection Board	70%
O-6	21–23 Years	3 Years	Best Qualified-Selection Board	50%

C. EXISTING BILLET REQUIREMENTS FOR ADVANCEMENT AND CAREER PATHS IN THE HELLENIC NAVY

The HN, as a military organization, has specific billet requirements (specified number of deck officers to promote at each pay grade, sea and shore tours, minimum years for sea tours, and a career path) for its personnel to receive promotions and "climb" into the pyramidal hierarchy. These elements are explained and thoroughly in the following discussion.

1. Deck Officers' Tours in the Hellenic Navy

After four years (with hard training and education), new deck officers are almost ready to join the Hellenic Fleet. Just before their first tour, they participate in a four-month course based on what they are going to encounter in their next sea tour. It is a more specialized education and training based on what they have learned from the HNA. The new deck officers are trained theoretically (in class courses) and practically (under way with ships of the Hellenic Fleet) upon the equipment that they are going to handle aboard ships and the duties that they will have. This course is their first grade in the HN, and it plays a significant role in their career. As Plato, the ancient Greek philosopher, said, "A well begun is half ended" (*ή αρχή είναι το ήμισυ του παντός*): so, the deck officers' first steps are very important. The deck officers' career paths in the HN follow the requirements of the officers' grades. The big difference with the USN is that in the HN, deck officers do not have the system of sea and shore tours. In the HN, the deck officers follow a pyramid system according to the specific time at any grade, and, as described previously, according to classes. Thus a typical path is as follows: as ensign (or O-1), deck officers remain for at least four years (with at least three of them at sea tour); as lieutenant junior grade (or O-2) five years (with at least three years of at-sea tours or nine years total as an officer); as lieutenant (or O-3) six years (with at least three years at sea tours or 15 years total as an officer); as lieutenant commander (or O-4) six years (with two years at sea tours, in which one year as CO or 21 years in total as an officer), commander (or O-5) six years (with two years at sea tours, in which one year is as CO or two years as CO in both ranks of lieutenant commander (or O-4) and commander (or O-5), or 27 years in total as an officer); and as captain (or O-6) four years (with at least 10 years at sea tours total and one year as CO in ships command).

In their first sea tour, for at least two years, the new deck officers at the grade of ensign (O-1) are in service on guided-missile frigates with helicopters (FFGH's) of the Hellenic Fleet. Their primary goal is to gain as much experience as they can, develop their skills and qualifications in naval operations, and get used to the sea element. They participate in all of the departments of sea operations (such as navigation, communications, weapons, operations in CIC, and in damage control as coordinator).

They are assistant officers in a rotational mode of training; they have under their command a small number of petty officers pertaining to a specific area of operations; and they are under training from the executive officer (XO) for at least six months. After the first two years, deck officers can receive their next sea tour in other ships of the Hellenic Navy, such as submarines, fast patrol boats, gun boats, mine hunters, general support ships, auxiliary ships, and helicopters. At this point in their career paths the deck officers are getting more specialized aboard a ship, they are able to broaden their skills and qualifications, and they are getting more experience aboard a ship. The present research, does not examine the separations of deck officers (according to their sea tour with the kind of ship they served), and continues to view them as an entity.

As lieutenant junior grade (O-2), deck officers have an almost one-year break from sea duty. At this particular period all the deck officers are participating at the specialization school, having the opportunity to receive the necessary specialization according to the needs of the Hellenic Fleet, and of course, their preferences. This shore tour is a great opportunity for the deck officers to be educated, and to cover aspects of their upcoming tours. The primary aspect of the specialization school is to give them all the knowledge/education in the technological fields and train them to become head of departments aboard ships. They are in charge of five to 15 petty officers. Finally at this period the deck officers as lieutenant junior grade (O-2) have the chance to obtain postgraduate education in universities in Hellas and abroad in the USA at the Naval Postgraduate School (NPS), or in England at Grandfield University in fields of science such as weapon systems engineering, electronic system engineering, meteorology/oceanography, computer engineering, and applied physics.

At the grade of lieutenant (O-3) deck officers continue their sea tours, for at least three years. They remain as head of a department aboard ship and they are in charge of two to five deck officers and a number of petty officers. As lieutenants (O-3) deck officers can become XO’s in every kind of ship in the Hellenic Fleet. After being in the Hellenic Fleet for the necessary period of time, deck officers have the opportunity to have a shore tour in headquarters such as the Hellenic National Defense General Staff (HNDGS), the Hellenic Navy General Staff (HNGS), the Fleet Headquarters, and so

forth, as staff officers and assistant officers in departments of those Headquarters, after having attending the Navy Staff Officer College. Also as lieutenants (O-3), deck officers are educated and trained in the staff officer course. Finally, at this pay grade, deck officers continue to have opportunities to obtain exactly the same postgraduate education as do officers in lieutenant junior grades (O-2).

At the next pay grade of lieutenant commander (O-4) deck officers begin their first sea tour as COs in submarines, fast patrol boats, gun boats, mine hunters, and small auxiliary ships. They must attend the small boat CO course for four to six weeks. They can remain for 12 to 24 months in this sea tour as COs. They also have shore tours in headquarters as staff officers, by becoming heads of departments. Additionally, as lieutenant commanders (O-4) all the deck officers may receive advanced training by attending the Supreme Joint War College. At this particular pay grade of lieutenant commander (O-4), they can have their final chance to obtain postgraduate education in universities in Hellas and abroad in the USA at the NPS, or in England at Grandfield University in fields of science such as management, operational research, and national security affairs.

As commanders (O-5) deck officers have their second sea tours as COs, in frigates or in big auxiliary ships (amphibious and general support ships). They can remain as CO for 12 to 24 months, after attending the big boat CO course for four to six weeks. They also have shore tours in headquarters as staff officers, by becoming head of departments, and are in charge of 50 deck officers, petty officers and enlisted personnel. Also at the pay grade of commander (O-5), they have their final chance to attend War College. Further, as commanders, deck officers can have shore tours abroad, in Hellenic Embassies and in NATO's organization positions.

Finally, as captains (O-6), deck officers can have shore tours in headquarters as heads of branches and be in charge of 10 to 20 deck officers and a large number of petty officers and enlisted. Their basic requirement for promotion to the next pay grade is to have a sea tour as CO in a ship's command (frigates, submarines, fast patrol boats, guns boats, mine hunters, and auxiliary ships) for at least one year. This is the last sea tour that a deck officer may have in the HN.

2. Billet Requirements for Advancement

Tables 4 and 5 are based on the ordinance of the Hellenic Republic 3883/167/A/September 24th, 2010, and show the direct orders in which the deck officers in the HN evolve in their career. The second column of Table 4, shows the required years in each pay grade; in the third column, shows the total years in service required for promotion to the next rank. The fourth and fifth columns of Table 4 show the least number of years of sea tours that are needed for advancement and the special requirements in each rank, respectively.

Table 4. Rank Requirements in the Hellenic Navy for Advancement

Pay grades in Hellenic Navy	Required years in each pay grade	Total years in service	Least number of years of sea tours for advancement	Special requirements for advancement
Ensign (or O-1)	4	-	3	-
Lt Junior Grade (or O-2)	5	9	3	-
Lieutenant (or O-3)	6	15	3	-
Lt Commander (or O-4)	6	21	2	2 years at sea tour with 1 year as CO in O-4
Commander (or O-5)	6	27	2	2 years at sea tour or 2 years in the Fleet Headquarters or Higher Ships Command and 1 year as CO in O-5 or 2 years as CO in both O-4/O-5
Captain (or O-6)	4	31	-	At least 10 years at sea tours and 1 year as CO in a Ships Command

Table 5. Rank States in the Hellenic Navy in 2012

State	Rank	Years in grade
1	Ensign	1

2	(O-1)	2
3		3
4		4+
5	Lieutenant Junior Grade (O-2)	1
6		2
7		3
8		4
9		5+
10	Lieutenant (O-3)	1
11		2
12		3
13		4
14		5
15		6+
16	Lieutenant Commander (O-4)	1
17		2
18		3
19		4
20		5
21		6+
22	Commander (O-5)	1
23		2
24		3
25		4
26		5
27		6+
28	Captain (O-6)	1
29		2
30		3
31		4+

In Table 5, the sign + indicates deck officers who will remain at the same pay grade either due to their lower performance or because they have not fulfilled the appropriate requirements for promotion to the next higher rank.

The career paths that deck officers follow in the HN, is depicted in Figure 1, in accordance with the ordinance of Hellenic Republic 3883/167/A/September 24, 2010. Figure 1 is a graphic depiction of the ordinance based on years at each rank, and when deck officers promote or not.

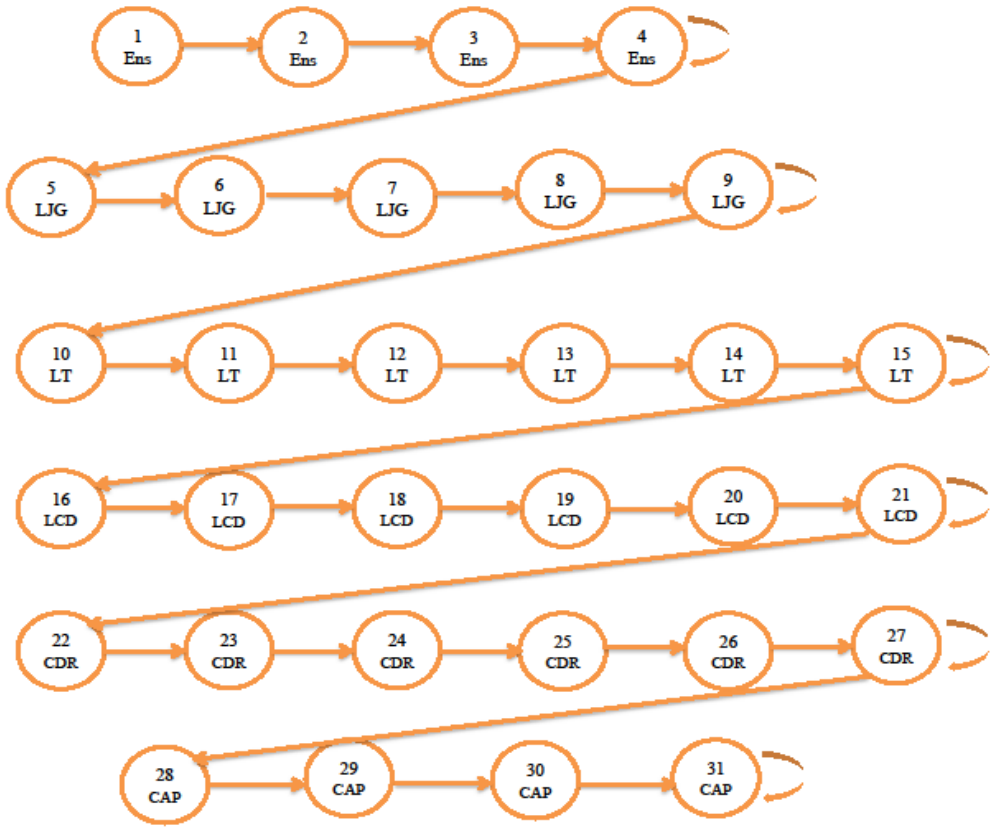

Figure 1. Career Path in the Hellenic Navy According to the Ordinance of Hellenic Republic 3883/167/A/September 24th, 2010

Following this career path, all deck officers can be promoted to the next grade after a specific period of time (depending on the grade), having fulfilled all the necessary requirements at the current grade (sea tours, shore tours, educational training), and according to classes. Because of the pyramid structure inside and the current career path at every pay grade deck officers may remain at their pay grade, as it shown in Figure 1, if they do not have the appropriate performance (this can be shown by the loops at each pay grade).

If we compare the career path that the USN uses for SWO's with the corresponding one in the HN for its deck officers, we find many similar procedures (basically in the sea/shore tours and education). The basic and most significant difference

has to do with the possibility of earlier promotion and its motivation in the USN, which does not exist in the HN operation. This particular feature of the USN system is an important focal point for the present research.

D. LITERATURE REVIEW FOR MANPOWER MODELING AND PROBLEM FORMULATION

A manpower modeling optimal problem is characterized by the decision maker upon a system. The decision-maker can observe the existing situation of this system and introduce decisions to stop, to continue, or to change/revise the direction of the system, based on the results of the model. The key point of the majority of the optimal manpower problems has to do with the Markovian nature of the decision, which relies on the value or values of an existing state/situation. Two possible outcomes can result for the system. The first outcome is a reward or a surplus, and the second is a cost at any additional time period. At this point, a critical decision must be made about whether to stop, continue, or change the system. If the decision for the system is to continue, then the reward for the next time period must be received, according to the probability of the next state/situation, for the decision-maker to optimize the system. Many researchers explain and solve for these types of modeling problems using dynamical programming techniques, as in dynamical programming and stochastic control (Bertsekas, 1976), applied computational economics and finance (Miranda & Fackler, 2002), and dynamic economics (Adda & Cooper, 2003).

1. Manpower Modeling

The following excerpts describe the conceptual basis of manpower modeling and are drawn from *Military Manpower Modeling and Mountain Range Options* (Hall, 2009):

> Manpower models need to answer questions for the planner. The structure of the force may be already set or may be product of exploration. Models are often used for forecasting and cost estimation, as well as to investigate the feasibility of proposed structures. Manpower models are designed to help with some aspect of creating and sustaining a force of workers to accomplish the organization's objectives or mission. Much of the literature focuses in those industries and application areas where there is a human delivered element of the product or service e.g. education,

> consulting and defense. The area of manpower planning has been an interdisciplinary area of research that is not unique to the military, but is a function of all large organizations. Manpower models have been employed to study human resources in the military environment since the conception of military operations research. Manpower models were created to model the type of personnel system used by the military, but have not been restricted in application strictly to the military modeling domain. Military manpower models have primarily been employed where the personnel system can be modeled as a closed system with several distinct stages or ranks, and where a predominant feature is a bar to lateral entry. In this manner, manpower models must account for the need to grow the experienced personnel that are needed within the system. The academic workforce has also been routinely modeled as a multi-class manpower system, as entry is traditionally at the assistant professor level, followed by promotions to associate professor, and finally to professor. Manpower models have also been used to analyze assigning workers to shifts and other problems that address matching personnel to jobs and job scheduling. Three types of mathematical models have been used in the preponderance of operating management, operations research, and management science manpower models. The early models were predominantly solved using dynamic programming. Dynamic programming papers often cited manpower models as one of the sources of their application and motivation for the developed mathematical methods. A second type of model is the transition-rate/Markovian manpower model. These probabilistic models are treated both in the operations research literature as well as the probabilistic literature. The last major type of model is linear and goal programming. In mathematical programming the manpower system is traditionally modeled as a network, and policy decisions are modeled using constraints on the multiple competing components of the objective function. (pp. 2-3, 54-55)

2. Manpower Modeling for Officer Career Decisions

Also, more specifically, regarding the modeling of officer decisions, Hall (2009) states:

> The career decisions of an officer may be influenced by many factors, but clearly economics will be a major consideration. With all the pressures of serving as an officer, there must be some compensation that outweighs the other career options at different stages of the officer's career. The officer does not know how many

> times they will be promoted when they are commissioned, but the uncertainty begins to be resolved over time. In our model, the officer knows their current rank, years in grade and years of service, and is then assumed to choose optimally between the compensation of continuing to serve versus retiring from the military and starting a second career. (p. 21)

3. States

The model examined for the HN case has as its primary purpose to consider all the deck officers in the ranks of ensign (O-1) to captain (O-6), and to search for a flexible and more productive career path for them, by using possibilities of earlier promotion to the next rank of ensign (O-1), lieutenant junior grade (O-2), lieutenants (O-3), lieutenants commander (O-4), and commander (O-5). In the proposed model for deck officers in the HN, each state is represented by other grades, such as the total years in service, and the time at each grade. All the ranks of deck officers are used in the model at each state according to the opportunity to have an earlier promotion.

Table 6 compares the states in the new network model for the deck officers in the HN with the currently-used career path. All states are numbered according to the current career path in the HN (in a direct sequence) from 1 to 31. Deck officers in the HN are being promoted according to a certain career time. With the proposed model, five opportunities exist for earlier promotions (for one year than the current career path) to the next higher rank. According to this, one can create an earlier promotion to lieutenant junior grade (O-2), lieutenant (O-3), lieutenant commander (O-4), commander (O-5), and captain (O-6), as those shown in Figure 5, Suggested Model for the Hellenic Navy. The five opportunities for earlier promotion in the proposed model will create fifteen career paths to captain, which reflect all of the combinations for earlier promotions.

4. Transitions

Finally, regarding the transitions in a manpower model, Hall (2009) explains the approach as follows:

> Each year is modeled as a period, and the officer progresses though the Markov chain (described in Figure 1). The officer knows his/her current state, which includes information on rank, years at

> current rank, as well as years of service. The transition matrix does not allow for demotions, and as such has all zero elements below the diagonal. States are naturally grouped by rank with the transition matrix describing increasing seniority within the current rank, as well as promotions to the next rank. The extra states within each rank are necessary to capture the information necessary for retirement and promotion calculations. Pay is not dependent on the path taken to any state, only on the current rank and time service, information which is contained in each rank state and the model's time variable. (p. 32)"

E. INTRODUCTION OF A NEW MODEL IN THE HELLENIC NAVY

Before introducing the model for the career path of the deck officers in the HN, it is important to better understand the structure of the larger Hellenic Armed Forces (HAF), as well as the motivation that plays a very significant role in every manpower model and, more particularly, within the armed forces.

The HN is a branch of the HAF. As seen in Figure 2, the HAF are composed of three branches, which include the Hellenic Army, the Hellenic Navy, and the Hellenic Air Force. According to the infrastructure of the HAF (referred in the official webpage of the HMoD, and shown in Figure 2), effectiveness is a key player in modernizing the HAF, especially at present in the very unstable geostrategic and geopolitical area where Hellas stands.

1. New Infrastructure of the Armed Forces

The HN is a branch of the HAF. As seen in Figure 2, the HAF are composed of three branches, which include the Hellenic Army, the Hellenic Navy, and the Hellenic Air Force. According to the infrastructure of the HAF (referred in the official webpage of the HMoD, and shown in Figure 2), effectiveness is a key player in modernizing the HAF, especially at present in the very unstable geostrategic and geopolitical area where Hellas stands:

> In order to create effective Armed Forces, able to respond to the principles of our country's defense policy it is necessary: To develop in land flexible, rapid and effective forces with shield-protection, great power, fire effectiveness, as well as an appropriate organization and structure, able to ensure the territorial

integrity of the landlocked and insular country and to contribute to Cyprus defense. To develop at sea a naval power that will be able to protect our legal rights for sovereignty, to defend the Hellenic coasts and islands by sea, to keep the sea lines of communications open, to show power in land and to emphasize our naval presence to all the Hellenic sea area and the widest area of East Mediterranean. To develop in the air an air force that will be able to protect our rights for sovereignty, to ensure the air defense of the country, to support the other Branches of the Armed Forces trying to protect the integrity of the landlocked and insular country, as well as to assure the operational capability in the widest area of East Mediterranean. To maximize the capability of joint action of all the Branches of the Armed Forces, emphasizing on the inter-service complementarity so that will be able to carry out combined operations in the direction of the implementation of the mixed operational doctrine to the special environment of every possible Operations' Theater for the achievement of the objectives of our defense strategy. To reform the potency of the three Branches according to the modern operational specifications and demands of NATO, according to our national defense planning, aiming at the effectiveness and rapidity of the forces' reaction and the concurrent reduction of their costs.

Figure 2. The Three Branches of the Hellenic Armed Forces

2. Modernization of the Armed Forces

The HAF is a living organization that must stay in step with the fast pace of modern times. The Hellenic Ministry of Defense (2012) addresses this theme very specifically in a statement regarding "Modernization of the HAF":

> The modern security and defense environment, the rapid developments in military technology and the new terms of war's conduct, necessitate the complete change of the Armed Forces' structure and philosophy. The international security environment today is complicated. The medium-term threat of a world war has been eliminated. However, national, religious, financial, social and environmental tensions keep on causing instability to the international security system and creating asymmetrical threats. This modern security environment is being characterized by: The elimination of the danger coming from north, since the relations of Hellas with the Balkan countries has been regularized. The persistence of the danger coming from east, despite the improvement of Hellenic-Turkish relations, given that the main problems with the neighboring country - the Aegean and the Cyprus issue - remain unresolved. The safeguarding of the reliability of the doctrine of the unified defense area with Cyprus. The appearance of new asymmetrical threats, which are connected to the instability in the countries of our north boarders. The participation in international peace- keeping operations. In order to respond to the requirements and conditions of this new era, the HAF adapt and remain powerful, flexible and effective. In this way, the HAF are able to deal with any threat against our country's new conditions of security. According to the aforementioned facts, the Hellenic Ministry of Defense (HMoD) plans and promotes some very important reforms having to do with the structure, organization and operation of the HAF. The changes that are being promoted concern the improvement of the three basic factors of the defense power, the structure of power and command, the weapon systems and the human resources. The new structure of the command is being promoted through the organizing modernization of the HMoD and through the re-assignment of the operational duties to the Chiefs of General Staffs, excluding any kind of interferences that are out of the institutional context, to the function of the Armed Forces. The changes related to the force structure concern the rearrangement of the country's Armed Forces in the Hellenic territory according to the new safety standards. More flexible, rapid and powerful units are being formed. The Army is being rallied and the strike forces are massed in Thrace and Aegean Sea in order to confront any kind of episode. The

> forces of Hipeiros and Macedonia protect the borders and confront new threats such as the international terrorism, the organized crime, the illegal migration and other phenomena that threat the country's security. The second force factor is the weapon systems. In the last years and after the crisis of Imia, procurement requirements for new weapon systems led to the increase of the supply costs without the expected enhancement of the domestic defense industry. Today the reform and the modernization of the domestic industry is being promoted, the greatest possible participation in the implementation of the armament programs and their complete utilization to the infrastructure, know how, research and development sectors, in combination with the achievement of high real Hellenic Added Value and finally, the ensuring of transparency and conditions of sound competition through the strict observance of the legal framework of the Armed Forces' procurements and the introduction of the institution "Review of Investment, Development and Implementation of an Administration of Armament and Quality System". Finally the effort for the improvement of the human resources, which is the third main factor of defense potency, is based on the following methods: The modernization of the "Professional Soldiers" initiative. The most important objective is the increase of their professional performance through the improvement of their training and the achievement of a more stable view of whatever is related with the support of their arming systems relatively with the reservists. The introduction of the institution of the Reservists of High Readiness in borderland. Up to 100.000 persons up to 35 years old are going to join the army every year. They will be paid according to their service time. Their salary will be the same with the salary of their classmate permanent colleagues and they will be especially trained in several schools according to their specialty or their rank. The improvement of the training at the Supreme Military Training Institutes, National defense College and Joint War College and the consideration of their diplomas as post-graduate studies.

Inside the very complicated environment (geographical, strategic, political, and economic) in which the HAF operates, the demands placed upon more senior personnel can be quite substantial, often requiring urgent action. Military organizations usually receive inputs through standard, slow-moving procedures, and reorganization is at a slower pace than in other non-military organizations. In the last decade of the previous century, this changed (urged on by the collapse of the USSR along with the emergence of terrorism worldwide), driving the armed forces to introduce innovations and to reorganize

their operations. The HAF responded to this, as well, by introducing changes and modifications as part of NATO. Also, the HAF, in responding to the vast national economic crisis, must strive to keep its operational readiness at even higher levels through extraordinary changes.

3. Motivation

Motivation is one of the most important topics inside all organizations. This is especially true for organizations such as the armed forces, which are structured according to a very strict pyramidal concept. Further, according to *Enhancing Organizational Performance* (Druckman, Singer & Van Cott, 1997): "Military organizations are greedy institutions, because they require a lot from their personnel. This is because during active duty, personnel are on a permanent, 24-hour call with rather idiosyncratic working shifts and their leave is subject to cancellation." (p. 202)

The HN, which is a common military organization, likewise has a very specific and demanding pace for its personnel. As described in *The Essentials of Organizational Behavior* (Robbins & Judge, 2012):

> The 3 key elements in our definition are intensity, direction, and persistence. Intensity describes how hard a person tries. This is the element most of us focus on when we talk about motivation. However, higher intensity is unlikely to lead to favorable job-performance outcomes unless the effort is channeled in a direction that benefits the organizations. Therefore, we consider the quality of effort as well as its intensity. Effort directed toward, and consistent with, the organization's goals is the kind of effort we should by seeking. Finally, motivation has a persistence dimension. This measures how long a person can maintain effort. Motivated individuals stay with a task long enough to achieve their goal. (pp. 72-73)

Perhaps, the most well-known theory of motivation is Abraham Maslow's "hierarchy of needs." Maslow hypothesized that, within every human being, there exists a hierarchy of five needs. These are shown in Figure 3. According to Robbins and Judge (2012, p. 73), these needs can be briefly defined as follows:

a. Physiological Needs.

At the bottom layer of the pyramid there are the physiological needs, which includes all the basic needs for living hunger, thirst, shelter, sex, and other bodily needs.

b. Safety Needs.

One layer up there are the safety needs. At this level security and protection play a significant role against any harm (physical or emotional).

c. Social or Belonging Needs.

When humans have satisfied the first two categories of needs (physiological and safety needs), they want and seek for more socialization. Here humans want affection, belongingness, acceptance, and friendship.

d. Esteem Needs.

Climbing higher up the pyramid, there are more factors to be satisfied. Those factors are internal such as self-respect, autonomy, achievement, and also external factors such as status recognition, and attention.

e. Self-Actualization Needs.

At the top level of the pyramid, there are the highest needs which drive people to become what they are capable of becoming. Self-actualization needs include growth, achieving one's potential, and self-fulfillment.

Figure 3. Maslow's Hierarchy of Needs

Finally, as described in Robbins and Judge (2012): "Although no need is ever fully gratified, a substantially satisfied need no longer motivates" (p. 73). Thus, as each of these needs becomes substantially satisfied, the next one becomes dominant. In Figure 3 we can see a depiction of Maslow's hierarchy theory. In the base of the pyramid there are all of the physiological needs (food, shelter, water, etc.). One step above, there are the safety needs (such as security and protection from physical/emotional harm). In the next upper step, there are the social needs and the human relationships. In the last two higher steps, there are internal and external factors for esteem, followed by self-actualization. Maslow separated the five steps into higher and lower order needs. The big difference between higher and lower order needs is that higher order needs can be satisfied internally, whereas lower order needs are satisfied externally.

According to *Managing the Poor Performer* (Stewart & Stewart, 1982):

> If we could draw a graph showing the relationship between motivation to do any task and the resulting standards of performance, the form of the graph is an inverted U. At low levels of motivation, performance is also at low standards. As motivation increases the standards of performance reaches an optimum level/area. After that level/area if motivation increases the standards of performance go down. This graph is depicted in Figure 4. (p. 36)

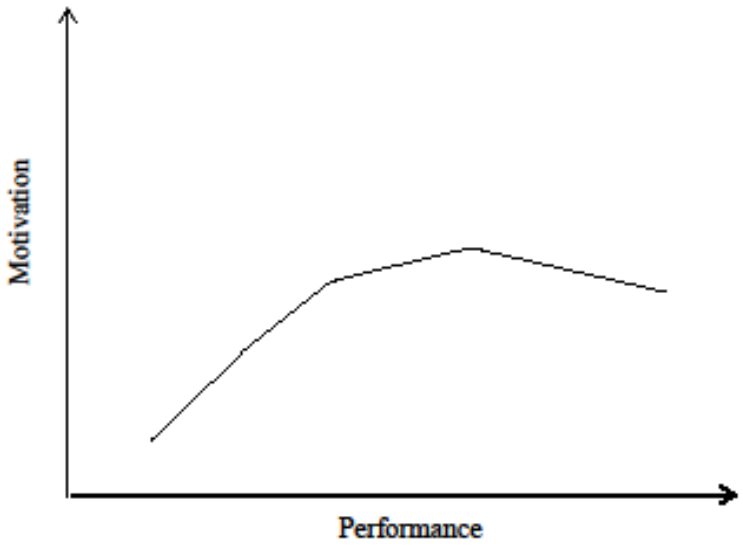

Figure 4. Motivation-Performance Graph (From Stewart & Stewart, 1982, p. 36)

4. Introduction of a New Model in the Hellenic Navy

In the past three years, Hellas has suffered substantially from the current financial crisis. Significant reductions in budgets have caused enormous cuts in the salaries of all the people who form the labor force in Hellas. The HmoD, as an organization of the Hellenic state, has also introduced budget reductions. To maintain operational readiness and effectiveness, all three branches (Hellenic Army, Hellenic Navy, and Hellenic Air Force) of HAF are exploring various manpower models.

The new model for the career path of deck officers in the HN is similar to the current one, with some basic modifications. These modifications are based on the concept of motivation. Clearly, motivation is a strong factor within all organizations. More specifically, the armed forces, as organizations operating under strict rules, requirements, and high demands, always strive to use motivation as a key element for achieving the best performance from their personnel.

The fundamental modification of the new model is based on the opportunity for deck officers to promote to the next pay grade without remaining at classes and

remaining at the pay grade for less time. This modification could possibly bring more flexibility (and more effectiveness) to the HN. It requires well-organized, well-structured, and thorough criteria for grading personnel performance (grading would occur annually not only by the grading forms of the CO, but also by examinations), and eliminating the imponderable factor of subjectivity. In this way, there would be a separation and a differentiation of all the deck officers. This would help to motivate deck officers with higher performance and push the HN to more effectively achieve its objectives and accomplish its mission. This alternative career path would be an extra incentive for deck officers to adjust their performance; and it would create two parallel structures for promoting the best performing deck officers among all the others at the same pay grade. Through this differentiation, higher-performing deck officers would have the opportunity to have the best sea and shore tours among the others. Deck officers with satisfactory performance would remain within the same career path and have the opportunity to obtain a higher performance rating during the next grading. The rest of the deck officers with moderate and poor performance would be at the second parallel structure, having sea and shore tours in more auxiliary deployments within the HN.

Further, introducing coefficients to achieve objectivity in promotions to the next pay grades in a shorter amount of time would give the HN the opportunity to choose among higher-performance deck officers. Only the best deck officers (those who have higher ratings) would be promoted and have the best sea/shore tours (as a reward for their high performance). This would concurrently gratify the higher-performing personnel and provide a clear incentive, by example, to others who can see how they may achieve the same opportunity through their next assignment. Thus, the new model can produce multiple benefits for manpower management of deck officers in the HN.

Table 6 and Figure 5 compare the current deck officers' career paths in the HN with the proposed change based on years at each pay grade. Here, one can also see the new opportunities for deck officers to have/receive earlier promotion. If this were introduced, new opportunities would be created for earlier promotion among deck officers, based on their performance (and only on it), and without the obligation to follow their class/cohort. For example, a deck officer who has the appropriate and necessary

high performance at all the ranks (from O-1 to O-5) may promote to O-6 at 22 years in service and not at 27 (with the existing career path). This would be an incentive for all the deck officers to try. We cannot forget that, in periods of deep recession, such as the present one, Hellas faces severe cuts not only in operational expenses, but also in personnel salaries. Consequently, this could be a very strong motivator for higher achievement among personnel.

Table 6. Rank States in Hellenic Navy (New Model)

State	Rank	Years in each grade	Total years in service	Years in grade (new model)	Total years in service (new model)
1	Ensign (O-1)	1	1	1	1
2		2	2	2	2
3		3	3	3	3
4		4+	4	-	
5	Lieutenant Junior Grade (O-2)	1	5	1	4
6		2	6	2	5
7		3	7	3	6
8		4	8	4	7
9		5+	9	-	
10	Lieutenant (O-3)	1	10	1	8
11		2	11	2	9
12		3	12	3	10
13		4	13	4	11
14		5	14	5	12
15		6+	15	-	
16	Lieutenant Commander (O-4)	1	16	1	13
17		2	17	2	14
18		3	18	3	15
19		4	19	4	16
20		5	20	5	17
21		6+	21	-	
22	Commander (O-5)	1	22	1	18
23		2	23	2	19
24		3	24	3	20
25		4	25	4	21
26		5	26	5	22
27		6+	27	-	

28	Captain (O-6)	1	28	1	23
29		2	29	2	24
30		3	30	3	25
31		4+	31	4	26

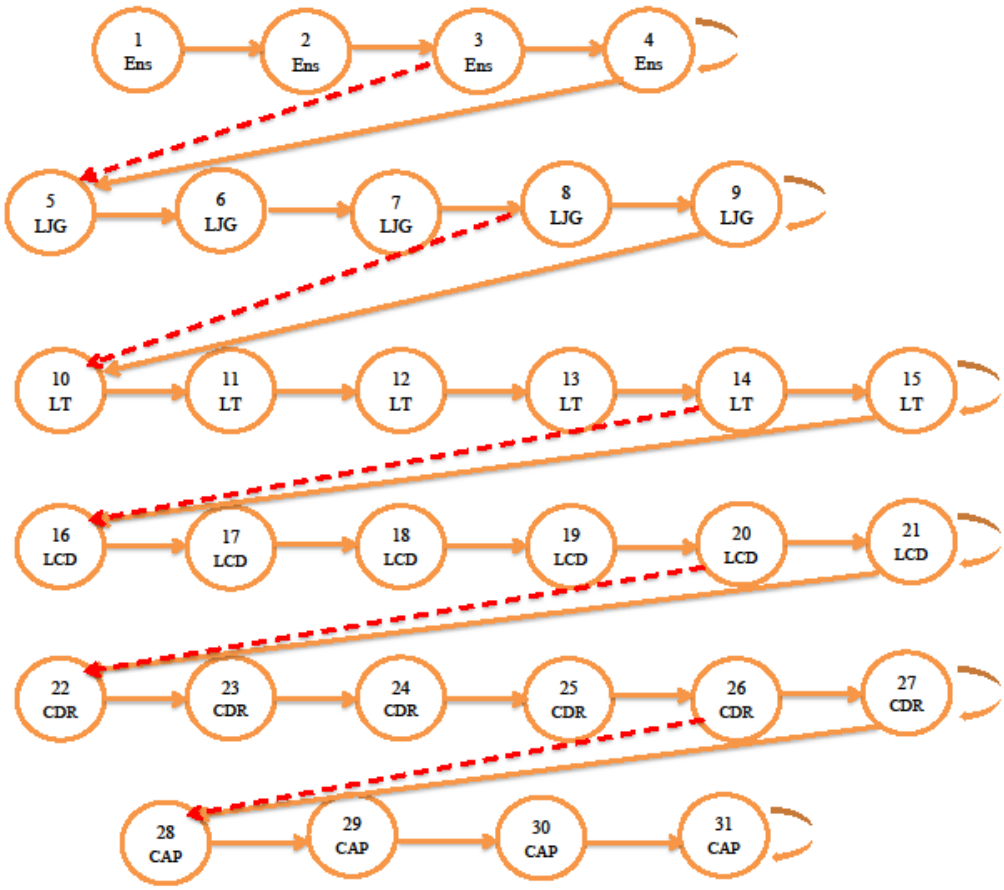

Figure 5. Suggested Model for the Hellenic Navy

III. METHODOLOGY

A. METHODOLOGY OF MARKOV MODELS

Markov models are probabilistic models that can describe the behavior of manpower systems and are widely used in human manpower management applications. They not only can be used to predict the aggregate behavior of the system, but also they can be used to model various elements of the system.

1. TRANSITION MODELS BASED ON THE THEORY OF MARKOV CHAINS

A model is essentially a description of the system together with a set of assumptions about the behavior of the uncontrolled variables. The assumptions may be based on two kinds of consideration the empirical and the hypothetical. With an empirical assumption, I mean one derived from the past observation in our system. A hypothetical assumption applies to a future condition of the system.

If a system is divided into k categories (grades and time in grade for our model) the transitions probabilities between each of the grades may be set out in an array as shown in Table 7. (Bartholomew & Forbes, 1979; Drescher 1989).

Table 7. Transitions Probabilities in an Array

p_{11}	p_{12}	...	p_{1k}	w_1
P_{21}	P_{22}	…	p_{2k}	w_2
.	.	…	.	.
.	.	…	.	.
p_{k1}	p_{k2}	…	p_{kk}	w_k

The element p_{ij} is the probability that an individual in state i at the start of the time interval is in state j at the end, while w_i is the probability that an individual in state i at the start has attrited by the end of the interval. One necessary assumption for the Markov chain are that individuals move independently and with identical probabilities which do not vary over time. Thus, for each person he/she must either stay at the same grade, move to another grade, or leave. The sum of rows for all i is depicted in Figure 6.

$$\sum_{j=1}^{k} (pij + wi) = 1$$

Figure 6. Summary of Transitions Probabilities (Bartholomew, Forbes & McClean, 1991, p. 97)

2. INVENTORY EQUATION

The Bartholomew's inventory equation is shown in Figure 7:

$$\boldsymbol{n}(t) = \boldsymbol{n}(t-1) \times \mathbf{P} + \mathrm{R} \times \mathbf{r}$$

Figure 7. Inventory Equation (Bartholomew, Forbes & McClean, 1991, pp. 99–100)

The $\boldsymbol{n}$(t) is a vector that describes the state of the inventory at time t. All the elements for **n** are expected numbers of individuals in that state at a specific period of time t.

P indicates the transition matrix. In our suggested model the dimensions of the transition matrix is 31 x 31.

R is a scalar which describes the total number of accessions in the specific period of time t.

r is also a vector that describes how the new recruits of the system are distributed in it. All the elements of **r**, are the proportion of the new accessions that arrive

in each state. In our model all new accessions come from the HNA. (Bartholomew & Forbes, 1979; Drescher, 1989).

The model for the HN depicted in Figure 5 is based on a Markov model. It shows all the possible states and describes all the allowable transitions, as well as the probabilities associated with each transition. We can implement this model as a matrix and leverage matrix algebra in order to simplify many important calculations. Let **P** = { p_{ij} }. That is the matrix (indicated by the capital letter P) of transitions probabilities. We have a total of 31 states. So the matrix of transition probabilities is a 31 x 31 matrix. Tables 8 through 13 describe the transition probabilities at each pay grade (from ensign to lieutenant junior grade, lieutenant junior grade to lieutenant, lieutenant to lieutenant commander, lieutenant commander to commander, and commander to captain) and all the possible 31 states.

Table 8. O-1 Transition Probabilities

	O1-1	**O1-2**	**O1-3**	**O1-4**	**O2-1**
O1-1	0	1	0	0	0
O1-2	0	0	1	0	0
O1-3	0	0	0	0,8	0,2
O1-4	0	0	0	0,15	0,8

Table 9. O-2 Transition Probabilities

	O2-1	**O2-2**	**O2-3**	**O2-4**	**O2-5**	**O3-1**
O2-1	0	1	0	0	0	0
O2-2	0	0	1	0	0	0
O2-3	0	0	0	1	0	0
O2-4	0	0	0	0	0,8	0,2
O2-5	0	0	0	0	0,15	0,8

Table 10. O-3 Transition Probabilities

	O3-1	**O3-2**	**O3-3**	**O3-4**	**O3-5**	**O3-6**	**O4-1**
O3-1	0	1	0	0	0	0	0
O3-2	0	0	1	0	0	0	0

O3-3	0	0	0	1	0	0	0
O3-4	0	0	0	0	1	0	0
O3-5	0	0	0	0	0	0,75	0,25
O3-6	0	0	0	0	0	0,2	0,75

Table 11. O-4 Transition Probabilities

	O4-1	**O4-2**	**O4-3**	**O4-4**	**O4-5**	**O4-6**	**O5-1**
O4-1	0	1	0	0	0	0	0
O4-2	0	0	1	0	0	0	0
O4-3	0	0	0	1	0	0	0
O4-4	0	0	0	0	1	0	0
O4-5	0	0	0	0	0	0,75	0,25
O4-6	0	0	0	0	0	0,2	0,75

Table 12. O-5 Transition Probabilities

	O5-1	**O5-2**	**O5-3**	**O5-4**	**O5-5**	**O5-6**	**O6-1**
O5-1	0	1	0	0	0	0	0
O5-2	0	0	1	0	0	0	0
O5-3	0	0	0	1	0	0	0
O5-4	0	0	0	0	1	0	0
O5-5	0	0	0	0	0	0,75	0,25
O5-6	0	0	0	0	0	0,2	0,75

Table 13. O-6 Transition Probabilities

	O6-1	**O6-2**	**O6-3**	**O6-4**
O6-1	0	1	0	0
O6-2	0	0	1	0
O6-3	0	0	0	0,85
O6-4	0	0	0	0,35

The model employs the alternative career path outlined in Figure 5. The structure of the proposed career path incorporates all the requirements at each pay grade while adding the incentive of early promotion.

The vector of new accessions has 31 elements, one for each state. Since the only new officers are Ensigns from the HNA, the first element of this vector is 1.0 and the rest are 0.

B. MANPOWER INVENTORY MODELS USING MARKOV MODELS

1. INTRODUCTION

As stated in *Statistical Techniques for Manpower Planning* (Bartholomew, Forbes & McClean, 1991):

> Manpower planning is often defined as the attempt to match the supply of people with the number of available jobs for them. This problem may be posed at the national or regional level, in which case it is likely to be an aspect of planning undertaken by government, or the department of defense. Equally, the problem arises in the management of individual firms or occupational groups. There are two features of most manpower planning problems which render them suitable for statistical treatment. The first one is concern with aggregates. Manpower planning, unlike individual career planning, is concerned with numbers, that is, with having the right numbers in the right places at the right time/moment. Aggregate and individual aspects are intimately related and cannot be separated but statistical methods are of the most direct relevance for handling the aggregate side. It cannot be too strongly emphasized that our concern with statistical approach is in no sense a denial of the importance of the other dimensions of human and organizational behavior. The second feature of manpower planning which needs statistical expertise is the fact of uncertainty. This happens not only because of the uncertainty inherent in the social and economic environment in which the organization operates, but also from the unpredictability which come from the human behavior. Any manpower planning must reckon with the key element of uncertainty by introducing probability ideas. The statistical aspects of the manpower planning have no differences from those in other scientific fields, such as applied statistics. There are four purposes which statistical methods serve in manpower planning, description, forecasting, control, and design. The first step at any kind of investigation will be to describe the system in numerical terms and to summarize the results in an easily and understood manner. Forecasting is the main activity of the statistical planning. Forecasting should never be interpreted as what will happen, but as what would happen if some assumed trends continue to exist. Parts of a manpower system are

> subject to control by management action, such as numbers, etc. The main object of the control theory is to devise strategies to ensure that changes take place in the desired direction. Finally, when an organization is being established or re-organized, it may design its structure and the mode of operation. (pp. 1-3)

2. FIXED RECRUTING MODEL

The purpose of the Fixed Recruiting Model is to examine the expected behavior of the whole system once the future recruiting plan is fixed. Note that fixed recruiting does not imply constant levels of recruiting. Tables 15 and 16 show the expected deck officer inventory for the next five years, holding the accessions constant (R = 25, as shown in Table 14) in our model.

Table 14. Number of Accessions in the HNA for the Next 5 Years

R	HNA	-	-		-	-	-
25	1	0	0		0	0	0
25	1	0	0	. . . . .	0	0	0
25	1	0	0		0	0	0
25	1	0	0		0	0	0
25	1	0	0		0	0	0

Table 15. Ensigns, Lieutenant Junior Grades, and Lieutenants From the Fixed Recruiting Model for the Next 5 Years (Years 2013–2017)

	O1-1	O1-2	O1-3	O1-4	O2-1	O2-2	O2-3	O2-4	O2-5	O3-1	O3-2	O3-3	O3-4	O3-5	O3-6
2012	29	25	18	24	32	36	38	45	40	60	48	48	36	59	73
2013	25	29	25	18	23	32	36	38	42	41	60	48	48	36	59
2014	25	25	29	23	19	23	32	36	37	41	41	60	48	48	39
2015	25	25	25	27	24	19	23	32	34	37	41	41	60	48	44
2016	25	25	25	24	26	24	19	23	31	34	37	41	41	60	45
2017	25	25	25	24	24	26	24	19	23	29	34	37	41	41	54

Table 16. Lieutenant Commanders, Commanders, and Captains From the Fixed Recruiting Model for the Next 5 Years (Years 2013–2017)

	O4-1	O4-2	O4-3	O4-4	O4-5	O4-6	O5-1	O5-2	O5-3	O5-4	O5-5	O5-6	O6-1	O6-2	O6-3	O6-4
2012	50	65	55	37	47	49	9	60	48	49	33	15	22	23	16	18
2013	70	50	65	55	37	45	49	9	60	48	49	28	20	22	23	20
2014	53	70	50	65	55	37	43	49	9	60	48	42	33	20	22	27
2015	41	53	70	50	65	49	41	43	49	9	60	44	44	33	20	28
2016	45	41	53	70	50	58	53	41	43	49	9	54	48	44	33	26
2017	49	45	41	53	70	49	56	53	41	43	49	18	43	48	44	37

3. FIXED INVENTORY MODEL

The only difference between the fixed inventory and the fixed recruiting model is that the end-strength targets are set ahead of time, rather than the recruiting plan. Tables 17 and 18 display the expected inventories for the next five years, holding the total inventory constant (approximately at the number of 1,207) in our model. Table 19 depicts the estimated accessions required to achieve those targets.

Table 17. Ensigns, Lieutenant Junior Grade, and Lieutenants From the Fixed Inventory Model for the Next 5 Years (Years 2013–2017)

	O1-1	O1-2	O1-3	O1-4	O2-1	O2-2	O2-3	O2-4	O2-5	O3-1	O3-2	O3-3	O3-4	O3-5	O3-6
2012	29	25	18	24	32	36	38	45	40	60	48	48	36	59	73
2013	24	29	25	18	23	32	36	38	42	41	60	48	48	36	59
2014	26	24	29	23	19	23	32	36	37	41	41	60	48	48	39
2015	29	26	24	27	24	19	23	32	34	37	41	41	60	48	44
2016	31	29	26	23	26	24	19	23	31	34	37	41	41	60	45
2017	33	31	29	24	24	26	24	19	23	29	34	37	41	41	54

Table 18. Lieutenant Commanders, Commanders, and Captains from the Fixed Inventory Model for the Next 5 Years (Years 2013–2017)

	O4-1	O4-2	O4-3	O4-4	O4-5	O4-6	O5-1	O5-2	O5-3	O5-4	O5-5	O5-6	O6-1	O6-2	O6-3	O6-4
2012	50	65	55	37	47	49	9	60	48	49	33	15	22	23	16	18
2013	70	50	65	55	37	45	49	9	60	48	49	28	20	22	23	20
2014	53	70	50	65	55	37	43	49	9	60	48	42	33	20	22	27
2015	41	53	70	50	65	49	41	43	49	9	60	44	44	33	20	28
2016	45	41	53	70	50	58	53	41	43	49	9	54	48	44	33	26
2017	49	45	41	53	70	49	56	53	41	43	49	18	43	48	44	37

Table 19. Estimated Accessions in the Proposed Model

R	HNA	-	-	. . . . .	-	-	-
24	1	0	0		0	0	0
26	1	0	0		0	0	0
30	1	0	0		0	0	0
31	1	0	0		0	0	0
32	1	0	0		0	0	0

C. SUMMARY

All military organizations are based on rank structures, and the specific time that personnel should remain at each pay grade. Fixed pay grades and specific billets at each rank compromise the chain of command inside the armed forces. The HAF does not differ from this generalized military model. A Markov model can provide a well-organized estimation/prediction about the career path in which the officers (and especially the deck officers in the HN) can flow, and manpower experts can estimate about the future of the elements (personnel).

The proposed model (which actually is an innovative modification of the existing one) is based on specific inputs, and outputs. The first input has to do with the accessions of the deck officers in the model, all of whom are implemented as O-1's when they

graduate from the HNA. The second input is about the fixed total amount of the deck officers in the HN. And the main output deals with the fixed transition probabilities in the career path of the deck officers. All of them are calculated in the suggested model in a period of the next five years, and a distribution of all the deck officers at each pay grade is estimated.

IV. RESULTS: THE APPLICATION OF THE NEW MODEL

A. BACKGROUND AND DATA

After the application of the ordinance 3883/167/A/September 24th, 2010, in the HN, there is the inventory of deck officers that is shown in Table 2 (page 9). The major problem for the HN is to ensure the numbers of deck officers at each pay grade correspond to the number of billets required. The suggested Markov model for the deck officers gives us the ability to divide the deck officers' inventory in the HN into two main categories. The primary-category contains the deck officers with higher performance than the others; this is called the "wet" deck officer' inventory. And the secondary category, which contains the rest of the deck officers, is called the "dry" deck officer' inventory.

B. BILLETS AND NEW REQUIREMENTS

We use the Markov models (the fixed accessions model and the fixed inventory model) to develop estimates for the years 2013 to 2017. The forthcoming paragraphs contain the results of both models with the applied assumptions.

1. FIXED ACCESSIONS MARKOV MODEL

For the fixed accessions Markov model we assume 25 deck officers will graduate from the HNA in each of the next five years. The expected inventories are shown in Tables 20 and 21. Table 22 shows the creation of the two parallel inventories by actual numbers for the years 2013–2017. The summary of deck officers in the HN is declining from 1,207 to 1,188 for the next five years (2013 - 2017) as shown in Table 23. The mark X in Tables 20, 21, 22, 23, 24, and 25 indicates that there are no promotion possibilities to the net rank for the deck officers in HN.

Table 20. Distribution of Deck Officers at Pay Grades of Ensigns, Lieutenant Junior Grades, and Lieutenants for the Years 2013–2017

	O1-1	O1-2	O1-3	O1-4	O2-1	O2-2	O2-3	O2-4	O2-5	O3-1	O3-2	O3-3	O3-4	O3-5	O3-6
2012	29	25	18	24	32	36	38	45	40	60	48	48	36	59	73
2013	25	29	25	18	23	32	36	38	42	41	60	48	48	36	59
2014	25	25	29	23	19	23	32	36	37	41	41	60	48	48	39
2015	25	25	25	27	24	19	23	32	34	37	41	41	60	48	44
2016	25	25	25	24	26	24	19	23	31	34	37	41	41	60	45
2017	25	25	25	24	24	26	24	19	23	29	34	37	41	41	54
2013	X	X	X	5	X	X	X	X	8	X	X	X	X	X	7
2014	X	X	X	6	X	X	X	X	7	X	X	X	X	X	10
2015	X	X	X	5	X	X	X	X	6	X	X	X	X	X	10
2016	X	X	X	5	X	X	X	X	5	X	X	X	X	X	12
2017	X	X	X	5	X	X	X	X	4	X	X	X	X	X	8

Table 21. Distribution of Deck Officers at Pay Grades of Lieutenant Commanders, Commanders, and Captains for the Years 2013–2017

	O4-1	O4-2	O4-3	O4-4	O4-5	O4-6	O5-1	O5-2	O5-3	O5-4	O5-5	O5-6	O6-1	O6-2	O6-3	O6-4
2012	50	65	55	37	47	49	9	60	48	49	33	15	22	23	16	18
2013	70	50	65	55	37	45	49	9	60	48	49	28	20	22	23	20
2014	53	70	50	65	55	37	43	49	9	60	48	42	33	20	22	27
2015	41	53	70	50	65	49	41	43	49	9	60	44	44	33	20	28
2016	45	41	53	70	50	58	53	41	43	49	9	54	48	44	33	26
2017	49	45	41	53	70	49	56	53	41	43	49	18	43	48	44	37
2013	X	X	X	X	X	7	X	X	X	X	X	10	X	X	X	X
2014	X	X	X	X	X	11	X	X	X	X	X	10	X	X	X	X
2015	X	X	X	X	X	13	X	X	X	X	X	12	X	X	X	X
2016	X	X	X	X	X	10	X	X	X	X	X	2	X	X	X	X
2017	X	X	X	X	X	13	X	X	X	X	X	9	X	X	X	X

Table 22. Inventories of Deck Officers in the HN

	O1+O2	O3	O4	O5	O6		O1+O2	O3	O4	O5	O6	"dry"
2013	287	324	303	214	79		X	+40	+86	+16	0	+142
2014	267	295	321	242	83		X	+11	+104	+44	+4	+162
2015	249	279	329	251	98		X	-5	+112	+53	+19	+180
2016	239	273	327	246	121		X	-11	+110	+48	+42	+190
2017	234	260	318	248	148		X	-24	+101	+50	+69	+195
Billets	400	284	217	198	79							

Table 23. Summary of Deck Officers in the HN for Fixed Accessions for Years 2013– 2017

n(**1**)	287	324	303	214	79
n(**2**)	268	295	321	242	83
n(**3**)	249	279	329	251	98
n(4)	234	273	327	246	121
n(5)	222	260	318	248	148

The columns with yellow shading at Tables 21 and 22 provide the number of deck officers in the HN who can receive an earlier promotion (by one year) at ranks of O-1, O-2, O-3, O-4, O-5, and O-6. In Table 23, the column shaded by blue indicates that O-1 and O-2 are excluded from the two parallel inventories (for reasons that are referred to and explained below). Also in Table 22, by the sign –there is a shortage of deck officers, by the sign + there is a surplus of deck officers. In other words in the last column of this table (shaded by green) there is the new parallel inventory of the deck officers (the "dry" deck officers). By introducing the two parallel inventories the HN can have the capability to keep the number of billets of the deck officers at the same numbers for the next five years.

2. FIXED INVENTORY MARKOV MODEL

For the fixed inventory Markov model, we assume officer end-strength is 1,207 for each of the next five years. Their distribution at each pay grade is shown in Tables 24 and 25. Table 26 shows the creation of the two parallel inventories by actual numbers for the years 2013–2017. Also in table 27 there are the actual accessions in the HNA for the years 2013–2017 according to the fixed inventory of deck officers of 1,207.

Table 24. Distribution of Deck Officers at Pay Grades of Ensigns, Lieutenant Junior Grades, and Lieutenants for the Years 2013–2017

	O1-1	O1-2	O1-3	O1-4	O2-1	O2-2	O2-3	O2-4	O2-5	O3-1	O3-2	O3-3	O3-4	O3-5	O3-6
2012	29	25	18	24	32	36	38	45	40	60	48	48	36	59	73
2013	24	29	25	18	23	32	36	38	42	41	60	48	48	36	62
2014	26	24	29	23	19	23	32	36	37	41	41	60	48	48	41
2015	30	26	24	27	24	19	23	32	34	37	41	41	60	48	47
2016	31	30	26	23	26	24	19	23	31	34	37	41	41	60	48
2017	32	31	30	25	24	26	24	19	23	29	34	37	41	41	58
2013	X	X	X	5	X	X	X	X	8	X	X	X	X	X	7
2014	X	X	X	6	X	X	X	X	7	X	X	X	X	X	10
2015	X	X	X	5	X	X	X	X	6	X	X	X	X	X	10
2016	X	X	X	5	X	X	X	X	5	X	X	X	X	X	12
2017	X	X	X	6	X	X	X	X	4	X	X	X	X	X	8

Table 25. Distribution of Deck Officers at Pay Grades of Lieutenant Commanders, Commanders, and Captains for the Years 2013–2017

	O4-1	O4-2	O4-3	O4-4	O4-5	O4-6	O5-1	O5-2	O5-3	O5-4	O5-5	O5-6	O6-1	O6-2	O6-3	O6-4
2012	50	65	55	37	47	49	9	60	48	49	33	15	22	23	16	18
2013	67	50	65	55	37	47	46	9	60	48	49	29	18	22	23	20
2014	54	67	50	65	55	39	43	46	9	60	48	45	32	18	22	27
2015	40	54	67	50	65	52	40	43	46	9	60	47	43	32	18	28
2016	45	40	54	67	50	62	52	40	43	46	9	57	48	43	32	25
2017	48	45	40	54	67	52	57	52	40	43	46	19	45	48	43	36
2013	X	X	X	X	X	7	X	X	X	X	X	10	X	X	X	X
2014	X	X	X	X	X	11	X	X	X	X	X	10	X	X	X	X
2015	X	X	X	X	X	13	X	X	X	X	X	12	X	X	X	X
2016	X	X	X	X	X	10	X	X	X	X	X	2	X	X	X	X
2017	X	X	X	X	X	13	X	X	X	X	X	9	X	X	X	X

Table 26. Inventories of Deck Officers

	O1+O2	O3	O4	O5	O6		O1+O2	O3	O4	O5	O6	"dry"
2013	287	324	303	214	79		X	+40	+86	+16	0	+142
2014	268	295	321	242	83		X	+11	+104	+44	+4	+162
2015	249	279	329	251	98		X	-5	+112	+53	+19	+180
2016	234	273	327	246	121		X	-11	+110	+48	+42	+190
2017	222	260	318	248	148		X	-24	+101	+50	+69	+195
Billets	400	284	217	198	79							

Table 27. Accessions of Deck Officers for the Years 2103–2017

Year	Accessions
2013	24
2014	26
2015	30
2016	31
2017	32

The columns with yellow shading at Tables 25 and 26 provide the number of deck officers in the HN who can receive an earlier promotion (by one year) at ranks of O-1, O-2, O-3, O-4, O-5, and O-6. In Table 27, the column shaded by blue indicates that O-1's and O-2's are excluded from the two parallel inventories (for reasons that are referred to and explained below). Also in Table 27, by the sign –there is a shortage of deck officers, by the sign + there is a surplus of deck officers. In other words in the last column of this table (shaded by green) we can see the new parallel inventory of the deck officers (the "dry" deck officers). By introducing the two parallel inventories, the HN can have the capability to keep the billets of deck officers at the same numbers for the next five years (2013–2017); the accessions for that period are shown in Table 28.

C. APPLICATION IN THE HELLENIC NAVY

The application of the two parallel inventories of the deck officers in the HN needs a basic assumption. That has to do with the number of O-1s and O-2s who are excluded from those inventories. This happens for two reasons. The first reason is for practical purposes; as is apparent from the prediction for the next five years the total number of O-1 and O-2 is declining year after year. So, they are excluded and remain at

the same inventory. The second reason is more essential and functional; by keeping all the deck officers as O-1 and O-2 at the same inventory (with the only exception for those who can promote earlier in accordance with the probabilities at the third year as O-1 and the fourth year as O-2), this operates as motivation for higher performance to the other ranks.

So after the rank of O-3, there will be the introduction of the two parallel inventories. Each year from 2013 to 2017, there will be a second parallel inventory of the 142, 162, 180, 190, and 195 deck officers (as shown in the green shaded column in Tables 23 and 27). Those officers will have the same likelihood for promotion as all the other deck officers, if they successfully fulfill their requirements (career assignments). Of course, if some of them want to remain at the parallel inventory they can promote until the rank of O-6 (as concluding session), having tours in "secondary" positions.

In Figure 8, the suggested model for the deck officers in the HN is depicted in a network flow. By the letter W is shown the primary inventory of deck officers as "wet" ones, and by D the secondary inventory as "dry" ones. As can clearly be observed from the network flow, both inventories operate together and there is a continuous exchange of deck officers, by keeping the total number of deck officers (billets) constant at the primary inventory.

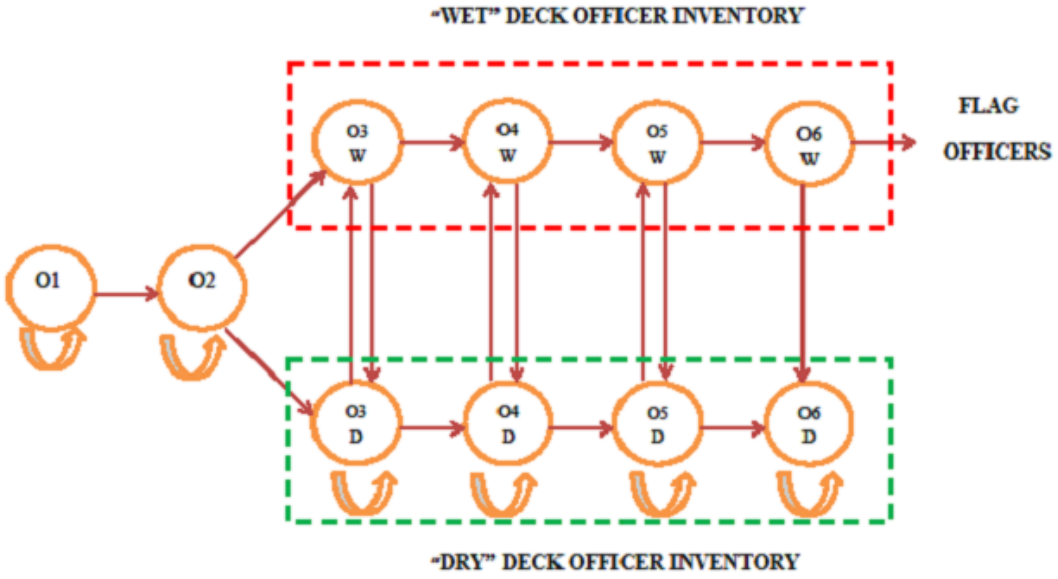

Figure 8. Suggested Model for the HN Network Flow

D. MODEL DESCRIPTION AND REQUIREMENTS

The application of the Markov model for the period of 2013–2017 can adjust the distribution of the deck officers to the designated billets. This creates two different but parallel inventories for the deck officers. The first primary inventory ("wet" deck officers) consists of the top performance deck officers, based on their annual evaluation system. The other one, the secondary one, contains all the other deck officers ("dry" deck officers). Both inventories ("wet" and "dry" deck officers) have very close relationships in order to exist interactions/exchanges for those who achieve higher performance to have the probabilities to enter the "wet" deck officers' inventory and vice versa.

If the required number of deck officers, is fulfilled, all the rest of the deck officers, automatically enter the secondary inventory. If the number is not fulfilled, then from the secondary inventory, the top performance deck officers are "mounting" to the main inventory. Those interactions/exchanges can adjust any obvious gap between the two inventories, and the required number of billets for the deck officers remains constant. The last opportunity for exchange can happen at the rank of O-5, because after that point,

all of the deck officers who are in the secondary inventory remain there until their retirement.

Based on the suggested model, the HN must re-consider the annual evaluation system. Currently this system contains by specified categories, which are shown in Table 28:

Table 28. Existing Annual Evaluation System

Number	Category	Subcategories/Elements
1	Duties/Experience	
2	Health/Body category	- Body conditions - Health conditions - Annual fitness report
3	Mentally qualifications	- Intelligence/judgment - Communications skills (oral and written) - Perception of reality
4	Spiritual qualifications	- Courage in physical dangers - Initiative - Cooperation - Stress
5	Management skills	- Authority - Caring about subordinates' needs - Managing subordinates effectively - Energetic activities - Foresight - Organizational abilities
6	Special skills	
7	Professional proficiency skills	- Professional experience - Training abilities - Caring about public money - Staff abilities - Methodicalness
8	Naval proficiency skills	- Sea sickness - Experience in seamanship - Ship handling
9	Morale qualifications	

Because of the introduction of motivation as a significant factor for the career path of the deck officers in the HN, it is necessary to introduce motivation into the

evaluation system with a significant coefficient/weight. Also, the education level of the deck officers has an important role in the evaluation system. In Table 29, there are the proposed new fields in the Annual Evaluation System and the revised ones marked in red.

Table 29. Suggested Introductions in the Annual Evaluation System (With Red Color)

Number	Category	Subcategories/Elements
1	Duties/Experience	- Actual years in sea tours and shore tours
2	Health/Body category	- Body conditions - Health conditions - Annual fitness report
3	Mentally qualifications	- Intelligence/judgment - Communications skills (oral and written) - Perception of reality
4	Spiritual qualifications	- Courage in physical dangers - Initiative - Cooperation - Stress
5	Management skills	- Authority -Caring about subordinates' needs - Managing subordinates effectively - Energetic activities - Foresight - Organizational abilities
6	Special skills	
7	Professional proficiency skills	- Professional experience - Training abilities - Caring about public money - Staff abilities - Methodicalness
8	Naval proficiency skills	- Sea sickness - Experience in seamanship - Ship handling
9	Morale qualifications	
10	Motivation	
11	Educational level	- Class seniority from the HNA - Class seniority from Lieutenant Junior Grade General Training - Class seniority from Navy Staff Officer College - Graduate studies - Other studies

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

Hellas has been in the midst of a tremendous financial crisis for the past three years. This financial crisis has led the country into a severe recession with various unpleasant measures taken by the Hellenic government. These measures have led to painful cuts in salaries across the labor force, as well as to significant reductions in the operational costs of organizations within both the public and private sectors. The recession continues to cause extreme difficulties for organizations throughout the nation, as the future seems very uncertain, at least for the short–term.

The HMoD, as a significant organization within the Hellenic government, faces a considerable challenge to keep its operational readiness at high levels, while making cuts in operational costs and personnel salaries. To assist the HMoD in meeting this challenge, the present research investigates whether having two parallel inventories for HN deck officers can result in higher performance by the officers and related organizational benefits, including increased flexibility.

B. CONCLUSIONS AND RECOMMENDATIONS

The primary and secondary research questions are presented in Chapter I. The following conclusions and recommendations are based on the results of the present study and are organized by these research questions.

1. Primary Research Questions

a. Should the HN Have a Second, Alternative Career Path for Deck Officers?

Conclusion:

The U.S. Navy uses an early-promotion career path for officers to distinguish between top and average performers. In the past two years, the HN has introduced the ordinance of Hellenic Republic 3883/167/A/September 24th, 2010. A short modification to the required years for promotion, with the opportunity for an earlier

promotion at each rank (from O-1 to O-6), similar to that used by the U.S. Navy, would provide the HN deck officers with an extra incentive for improved performance. Additionally, this alternative career path for deck officers would likely assist the HN in meeting its operational readiness objectives while offering increased organizational flexibility.

Recommendation:

Further study should examine more closely the prospect of introducing an alternative career path for deck officers, similar to the model developed for the present research. By dividing deck officers into two parallel inventories, the Department of Personnel of HNGS would have an improved ability to choose officers with higher performance. The primary inventory of the "wet" deck officers and the secondary inventory of the "dry" officers would operate on a more flexible career path by eliminating the seniority of classes/cohorts, and giving more opportunities to officers who want to climb the pyramid of the HN.

b. Could Two Parallel Structures for Deck Officers Operate Together Effectively?

Conclusion:

The two parallel inventories can operate with a simple clarification on deck officers' performance in specific areas by criteria in the HN fitness reporting system. These criteria are intended, on the one hand, to eliminate subjectivity and, on the other hand, to emphasize the performance of personnel. This would happen by introducing new elements as primary factors in motivating the performance of deck officers.

Also, the two parallel inventories would be in a continuous exchange of personnel, as parts of the same vehicle. When the HN has a surplus of high-performing personnel, it would choose among those with the higher scores, remaining in the primary inventory, while others would go to the secondary inventory. If the number of deck officers in the primary inventory is not filled, the HN will pick deck officers who they want from the secondary inventory to fill the gap.

Recommendation:

For the parallel operation of the two inventories of deck officers, the HN needs to examine more thoroughly all relevant factors, coefficients, and elements in the fitness report system, particularly those focused on motivation. Basically, all components should be reevaluated to insure that the two inventories operate together most efficiently.

c. Would a Second Career Path Provide the Desired Outcome of Improved Productivity and Flexibility?

Conclusion:

The harsh economic crisis cannot provide appropriate opportunities for better/higher salaries among personnel in any Hellenic organization. Nevertheless, the HN, by providing its deck officers with the motivation of achieving an earlier promotion and having a more desirable post at sea or shore tour, can possibly raise officer productivity and improve organizational flexibility. This would energize positively the existing rivalry among deck officers, and especially among those who desire achieving the rank of flag officer. Also, the secondary inventory of "dry" deck officers would operate as assistants to the primary inventory of "wet" deck officers, without excluding those who want to be promoted but do not have the necessary performance. In almost any circumstance or condition, the two inventories would interact positively with each other for improved productivity and flexibility.

Recommendation:

To gain as much as possible from the two parallel inventories, the HN should estimate the actual number of accessions needed over the next five years and introduce the suggested model on a test basis. During the trial period, various adjustments or changes might be required to ensure that the model works most effectively. After this, the results can be analyzed in deciding if the model should be introduced on a more permanent basis.

2. Secondary Research Questions

a. What Actions or Systems would be Needed to Ensure that Two Separate Structures could Operate Together Most Effectively?

Conclusion:

Every year after graduation from the HNA, deck officers would be under specified scrutiny or evaluation (with the same "weight" applied for each factor). To better apply the two parallel inventories, the required billets for O-1 and O-2 are not included in the total number of the deck officers. All deck officers would have the same opportunities based on their performance and their motivation to "climb" the hierarchy. The system would exclude deck officers who do not want to gain opportunities for development, those with relatively poor performance, and those who voluntary choose to remain in service for the minimum number of years.

Recommendation:

The Department of Personnel of HNGS's annual evaluation system should consider introducing the component of motivation, with a significant weight coefficient.

b. What Types of Further Research (e.g., a Pilot Program) would be Required to Determine Feasibility?

Conclusion and Recommendation:

This secondary research question is addressed above. A pilot program would be a good, first step toward introducing a parallel career path for deck officers. The HN should conduct similar research for other communities of officers. Indeed, a pilot program for deck officers would be a useful starting point in determining if a similar approach could be applied more generally to achieve the same objectives during these challenging times.

APPENDIX A - MARKOV FIXED ACCESSION MODEL

	O1-1	O1-2	O1-3	O1-4	O2-1	O2-2	O2-3	O2-4	O2-5	O3-1	O3-2	O3-3	O3-4	O3-5	O3-6	O4-1	O4-2	O4-3	O4-4	O4-5	O4-6	O5-1	O5-2	O5-3	O5-4	O5-5	O5-6	O6-1	O6-2	O6-3	O6-4
O1-1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O1-2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O1-3	0	0	0	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O1-4	0	0	0	0.15	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O2-1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O2-2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O2-3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O2-4	0	0	0	0	0	0	0	0	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O2-5	0	0	0	0	0	0	0	0	0.15	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O4-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O4-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
O4-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
O4-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
O4-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0.2	0	0	0	0	0	0	0	0	0
O4-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.75	0	0	0	0	0	0	0	0	0
O5-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
O5-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
O5-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
O5-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
O5-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0.2	0	0	0
O5-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.75	0	0	0
O6-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
O6-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
O6-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.85
O6-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.35

	O1				O2					O3						O4						O5						O6				TOTAL
n(0)	29	25	18	24	32	36	38	45	40	60	48	48	36	59	73	50	65	55	37	47	49	9	60	48	49	33	15	22	23	16	18	1207
n(1)	25	29	25	18	23	32	36	38	42	41	60	48	48	36	62	67	50	65	55	37	47	46	9	60	48	49	29	18	22	23	20	1208
n(2)	25	25	29	23	19	23	32	36	37	41	41	60	48	48	41	54	67	50	65	55	39	43	46	9	60	48	45	32	18	22	27	1207
n(3)	25	25	25	27	24	19	23	32	34	37	41	41	60	48	47	40	54	67	50	65	52	40	43	46	9	60	47	43	32	18	28	1202
n(4)	25	25	25	24	26	24	19	23	31	34	37	41	41	60	48	45	40	54	67	50	62	52	40	43	46	9	57	48	43	32	25	1196
n(5)	25	25	25	24	24	26	24	19	23	29	34	37	41	41	58	48	45	40	54	67	52	57	52	40	43	46	19	45	48	43	36	1188

n(1)	5	8	7	7	10
n(2)	6	7	10	11	10
n(3)	5	6	10	13	12
n(4)	5	5	12	10	2
n(5)	5	4	8	13	9

	O1+O2	O3	O4	O5	O6		O1+O2	O3	O4	O5	O6	
n(1)	287	324	303	214	79		x	-40	-86	-16	0	-142
n(2)	268	295	321	242	83		x	-11	-104	-44	-4	-162
n(3)	249	279	329	251	98		x	5	-112	-53	-19	-180
n(4)	234	273	327	246	121		x	11	-110	-48	-42	-190
n(5)	222	260	318	248	148		x	24	-101	-50	-69	-195
	400	284	217	198	79							

R	r																															
25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX B - MARKOV FIXED INVENTORY MODEL

LIST OF REFFERENCES

Adda, J. & Cooper, R. (2003). *Dynamic economics, quantitative methods and applications.* Cambridge. MA: MIT Press.

Ahuja, R. K., Magnanti, T. L., & Orlin, J. B. (1993). *Network flows, theory, algorithms, and applications.* Upper Saddle River, NJ: Prentice Hall.

Balakrishnan, N., Render, B., & Stair R. M. Jr. (2007). *Managerial decision modeling with spreadsheets.* Upper Saddle River, NJ: Prentice Hall.

Bartholomew, D. J., Forbes, A. F. and McClean, S. I. (1991). *Statistical techniques for manpower planning*. Chichester, England: John Wiley & Sons.

Baumgarten, P. B. (2000). *Optimization of the United States Marine Corps Officer career path selection.* (Master's thesis), Naval Postgraduate School.

Bertsekas, D. P. (1976). *Dynamic programming and stochastic control.* New York, NY: Academic Press.

Bertolino, L. G. (1990). *The effect of a US Navy reduction in forces on the career path of surface warfare officers processing to command at sea* (Master's thesis). Naval Postgraduate School.

Campbell, J. P., McCloy, R. A., Oppler, S. H., & Sager, C. E. (1993). A theory of performance: In personnel selection in organizations," edited by Neal Schmitt, Walter C. Borman and Society for Industrial and Organizational Psychology, San Francisco, CA: Jossey-Bass.

Drescher, R. B. (1989). *The Effect of the Goldwater-Nichols Department of Defense Reorganization Act on tactical aviation pilot and NFO career paths* (Master's thesis). Naval Postgraduate School.

Druckman, D., Singer, J. E., & Van Cott, H. P. (1997). *Enhancing organizational performance.* Washington DC: National Academy Press.

Dunn, J. D., & Stevens E. C. (1972). *Management of personnel: Manpower management and organizational behavior.* New York, NY: McGraw-Hill.

Erhenberg, R. G., & Smith, R. S. (2000). *Modern labor economics: Theory and public policy.* Boston MA: Pearson Education Inc.

Johnson, J. L. Jr.(1989). *Analysis of the Joint Reorganization Act's impact on personnel flow in the surface warfare officer community* (Master's thesis), Naval Postgraduate School.

Hall, A. O. (2009). *Simulating and optimizing: Military manpower modeling and mountain range options* (Doctoral dissertation), College Park, MD: Graduate School of the University of Maryland.

Hellenic Ministry of Defense. (2012a). Modernization of the Hellenic armed forces. Retrieved from http://www.mod.gr/en/armed-forces/modernization.html

Hellenic Ministry of Defense. (2012b). New infrastructure of the Hellenic armed forces. Retrieved from http://www.mod.gr/en/armed-forces/new-infrastructure.html

Hellenic Navy. (2012). Officer's career in the Hellenic Navy. Retrieved from http://www.hellenicnavy.gr/index.php?option=com_content&view=article&id=439&Itemid=386&lang=en

Mathis, R. L., & Jackson, J. H. (2009.) *Human resource management.* Mason, OH: South-Western Cengage Learning.

Michalaros, A. (2011). *Examination of individual performance using Markov models in the Hellenic Navy's Officer Performance Evaluations System* (Master's thesis), Naval Postgraduate School.

Miranda, M. J., & Fackler, P. L. (2002). *Applied computational economics and finance.* Cambridge MA: MIT Press.

Norhia, N, Groysberg, B., & Lee, L. E. (2008). Employee motivation: A powerful new model. *Harvard Business Review*, 86(7/8).

Presidency of the Hellenic Republic. (2010). Ordinance of the Hellenic Republic 3883/167/A/September, 24, 2010. Retrieved from http://www.et.gr /index.php?option=com_wrapper&view=wrapper&Itemid=108&lang=en

Rardin, R. L. (1998). *Optimization in operations research.* Upper Saddle River, NJ: Prentice Hall.

Robbins, S. P., & Judge, T. A. (2012). *Essentials of organizational behavior.* Upper Saddle River, NJ: Pearson.

Spencer, L. M. Jr. (1986). *Calculating human resource costs and benefits, cutting costs and improving productivity.* New York, NY: John Wiley & Sons.

Stewart, V., & Stewart, A. (1982). *Managing the poor performance.* Portsmouth, England: Gower Publishing Company Limited.

Stockard, J. G. (1980). *Rethinking people management: A new look at the human resources function.* New York, NY: AMACOM.

U.S. Navy Department of Personnel. (1990). *The naval officers career planning guidebook* (NAVPERS 15605). Millington: Navy Personnel Command.

U.S. Navy Department of Personnel. (2011). *Fitness report & counseling record (W2-O-6).* Millington: Navy Personnel Command.

U.S. Navy Military Development Center. (2012). Navy officer promotion process. Retrieved from http://www.military.com/MilitaryCareers/Content /0,14556,Promotions_Navy_ Officer,00.html

U.S. Navy. (1997). Navy officer promotions. *All Hands Magazine.* Retrieved from http://usmilitary.about.com/od/navypromotions/l/blofficerprom.htm

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